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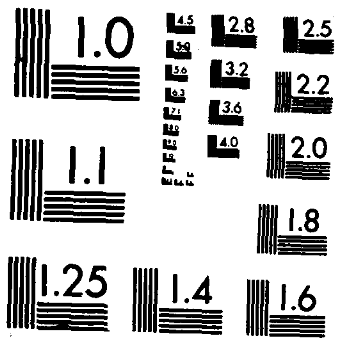

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AD-A174 483

AN ASSESSMENT OF THE ADVANCED

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THESIS

Michael J. Stapleton
Lieutenant, USN

AFIT/GLM/LSM/86S-82

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THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information are contained therein. Furthermore, the views expressed in the document are those of the author and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

Acknowledgments

The research which this thesis required was not without its moments of frustration and anxiety. My entry into the complex and foreign world of Navy Supply was as sudden as it was enlightening. I could not have digested nor appreciated the knowledge which was thrust upon me without the patient and generous support of the Repairables Management Branch at the Naval Supply Systems Command in Washington. My heartfelt thanks are extended to Kevin Fitzpatrick, Dave Estep, and Tim Kubik for their direction and assistance over the course of this project. I hope my efforts justified their investment. Of course, once I had acquired all of their expertise, I had the very competent guidance of my faculty advisor, Major Kent Gourdin to steer me towards completion. His low-key, "hands off" approach suited my methods well, while still providing a sense of partnership which I sincerely appreciated.

Michael J. Stapleton

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Abstract

The U.S. Navy has been constantly updating its collection of logistical support systems which are in place to provide world-wide support for fleet units. Such efforts have resulted in a new system for processing failed depot-level repairable components. The "Advanced Traceability and Control", or "ATAC" system uses techniques and procedures similar to those of commercial freight handlers to expeditiously transport and account for components being shipped to repair sites from Navy units all over the world. Because this system is so new, it has not been fully tested and compared with the previous system.

This thesis investigated the effect of the ATAC system on average transit or "retrograde" time of components being sent back for stateside repair. This evaluation compared the pre-ATAC mean retrograde time of failed components with that of items shipped via the new system. The results of the comparison indicated that the ATAC system seems to reduce the time a component spends in shipment. The implications of this discovery were discussed in terms of the financial impact and inventory management improvements of such a reduction. The thesis drew on the knowledge of experts in the field of Navy inventory management,

repairables management, supply, and finance to determine the potential significance of the ATAC system as implied by the results of the study. The overall conclusion contends that potential cost avoidance and savings in several areas are possible due to the increased efficiency of the ATAC system.

AN ASSESSMENT OF THE ADVANCED TRACEABILITY AND CONTROL (ATAC) SYSTEM

I. Introduction

As a globally-dispersed branch of the United States Armed Forces, the Navy, like her sister services, requires complex logistics systems to sustain its mission of power projection. However, with fleet units operating from stateside and overseas bases, as well as with over four hundred mobile, mostly seagoing units active on all of the world's oceans, the logistics systems of the Navy face unique obstacles. One of the more challenging of the issues confronting peace-time logisticians is the management of repairable parts. These components, once broken, are more economically repaired than replaced. As a result, they require transportation back from the using activities to stateside Designated Overhaul Points (DOPs) for repair. A complex, yet responsive system to effect the efficient transportation of these retrograde materials is a must.

In 1984, the Naval Supply Systems Command responded to fleetwide perception that the pipeline for return of its Depot Level Repairables (DLRs) was too long. Following reviews of the Naval Air Systems Command and the Naval Supply Systems Command by the Navy Inspector General in that year, it was recognized that there were faults in the retrograde transportation system, both in the transportation functions themselves, and in the processing and handling of DLRs between shipments. This lengthy time, from component failure to induction into repair, requires additional millions of dollars in inventory investment outlays, and degrades fleet readiness due to nonavailability of spares.

The Navy is currently implementing a new system to rectify this deficiency. Known as the Advanced Traceability and Control system, or ATAC, it is a program designed to improve the efficiency and effectiveness of the transportation and tracking of retrograde repairables. The system uses contractor freight forwarders, centralized component processing facilities, or "HUBs", and computerized telecommunication and data networks to quickly consolidate, process, and account for each repairable component as it travels to the DOP. Among ATAC's desired improvements are reducing transportation time, processing time, and repair-cycle pipelines, while enhancing carcass tracking and accountability, inventory control, and overall use of resources.(6:16)

Problem Statement

The development, testing and implementation of the ATAC system were very recent events. In 1985, the Navy conducted a fleet test of the ATAC system with favorable results. Official implementation was initiated soon thereafter, and the first HUB in Norfolk became operational 1 January 1986. As a result of this recent program implementation, a complete and accurate assessment of the system's alleged improvements has not yet been conducted. While most Navy officials agree that ATAC seems to be an improvement over the old procedures, there is little documentation to support this conclusion. This thesis will investigate the ATAC system, assess its performance, draw conclusions and make recommendations regarding its effectiveness.

Limitations on the Scope of the Study

In order to evaluate the performance of the ATAC system, some parameters which are measurable and reflective of the system's effectiveness must be identified. These parameters must then be compared with those of the pre-ATAC repairables management environment to gauge the improvements. Both systems must be evaluated in terms of cost. These costs are not always financial in nature and may reflect some non-quantifiable variables. One must investigate the comparative costs in terms of:

1. time in transit (both transportation time and port hold time.)
2. fleet workload, both administrative and physical,
3. lost or unaccountable components,
4. reduced fleet readiness because of inadequate spares support, and
5. outlays for transportation and services.

Because of the complexity and magnitude of this kind of analysis, this thesis dealt primarily with the analysis of transit or retrograde times. This time describes the interval between the requisition date of a component, and the receipt date of the failed carcass. Because of data collection deficiencies of pre-ATAC retrograde management information systems and procedures, valid data bases which accurately describe the transportation times of DLR shipments are essentially non-existent. The primary research objective of this thesis was to overcome this deficiency, and use the information generated to analyze the effectiveness of the ATAC process.

Despite the paucity of accurate and useable data, sufficient documentation existed which could be analyzed to construct a valid baseline. This documentation, in the form of Transaction History Files and B35 computer carcass tracking records, yielded a rough approximation of the transit time of a DLR. Refinement of this estimate was made through a variety of actions and assumptions to arrive at a useable transportation time baseline. Once derived, this baseline figure will be compared with similar figures available through the data collection functions of the ATAC system. This comparison only investigated the transportation time differences between ATAC and non-ATAC shipments. Conclusions were drawn based on the impact of the alleged time requirements differences.

These conclusions dealt with the inventory and cost issues directly related to the length of the Total Repair Cycle Time, which describes the entire period from component failure until it is restored to usable condition. Further analysis of the success of the other program objectives was not conducted. It is believed that construction of a valid pre-ATAC transportation time baseline will be of benefit to Navy officials in determining the value of and further improving the ATAC system.

There were several conditions which restricted or otherwise constrained the scope of this research. Due to the individual effort of this research, its status as an academic exercise, and the lack of strong command support, the full resources of the Navy's database management capability were not fully available for this research effort. This was certainly was understandable, as most of the agencies involved have an overabundance of official, high-priority tasking which commands their immediate and full attentions. Additionally, the cost of computer analysis and programming efforts is substantial, in both dollar and non-dollar amounts, and might not have served the best needs of the Service.

A prime constraining factor was the physical distances separating the Air Force Institute of Technology (AFIT) from the primary locations of interest in this study. While limited travel was performed both at personal and government expense, this did not compensate for the inability to deal with the various agencies on a frequent and face-to-face basis. As a result of this inaccessibility to the centers of information, such as Aviation Supply Office (ASO)in Philadelphia PA, Ships Parts Control Center (SPCC) in Mechanicsburg PA, Naval Supply Systems Command (NAVSUP) in Washington DC, and Navy Material Transportation Office (NAVMTO) in Norfolk VA, much of the research was conducted over the telephone. While not a disabling condition, it constrained the research effort.

Research Objectives

The task of determining the effectiveness of the ATAC system inspired and required some specific questions which guided the research. These questions are presented below.

I. Are there differences in pre-and post-ATAC transit times from overseas points to the U.S.?

II. Has ATAC reduced component travel time to the depot once they are in the continental United States (CONUS)?

III. Has ATAC affected processing requirements of DLRs at the repair depot, and if so, how has this affected the time from depot delivery to induction into repair?

IV. What is the significance of any changes in the transit time that are a result of the ATAC program?

These questions were the focus of the research, and their answers formed the basis for the conclusions and recommendations the report generated.

Importance of this Study

This analysis of ATAC's effectiveness is important to the Department of Defense (DOD). The fiscal resources of our modern Armed Forces are being allocated among programs of growing complexity and rising cost. This condition requires scrupulous management of precious defense dollars. In today's era of heightened public scrutiny of DOD management practices, and faced with the reality of congressionally-mandated budget cuts, the DOD has little room for error in its advocacy of expensive new programs. Therefore, any DOD support of these programs must be well-founded in fact and judgement. This research investigation will help provide some valid evidence to support the acceptance or rejection of the Advanced Traceability and Control system.

The goal of this research effort was to establish a valid baseline, which could be used to perform cost-benefit analyses of the ATAC system. Up to now, the comparisons of transit times have been based on best guesses, corporate "gut feelings" and some scattered hard data. As such, persuasive justification of ATAC's costs and procedures is difficult. And in an atmosphere of tightening budget constraints, lack of evidence supporting a successful program is not a comforting condition.

It is expected that this thesis will provide quantitative support for the continuation of the ATAC program. However, resistance to the ATAC program is not based solely on the lack of valid transit time data. There are also other questions of cost criteria, philosophical differences, political concerns, and perhaps, a resistance to change attributable to human nature. These doubts may or may not be eased by the results of this work. However, it is hoped that because of my research, the Navy will be in a better position to improve its repairables management programs and make better use of its resources.

II. Background Information

Repairables Management

The complex nature of modern weapons systems and military equipment has understandably led to more expensive subcomponents which make up these systems. Because of the increasing cost of procuring each new component, and due to improvements in maintenance techniques and technology, it has become more economical to repair certain failed components than to acquire new ones.(7:I-1) This condition has forced the Department of Defense to develop systems for procuring, stocking, distributing, repairing, and replacing complex and expensive components.

The responsibility for determining whether a new component is to become a repairable or a consumable part belongs to the Project Manager (PM) and the various Hardware Systems Commands (HSC) such as Naval Air Systems Command or Naval Sea Systems Command. This decision, made during the initial system acquisition process, is based on whether it is technically feasible to repair the item, and whether there is long-term cost effectiveness in the management of that item as a repairable.(7:III-1) Once an item is designated repairable, the determination of whether it becomes a Depot Level Repairable (DLR) or a Field Level Repairable (FLR) is made according to the technical skill and facility requirements needed to fix it.(7:I-2)

As the volume of repairable components increased, along with their costs, the Navy took steps to improve the management of these valuable assets. In the mid-1970s, the Navy ear-marked personnel and funds to upgrade the repairables management field. Known as the Improved Repairables Asset Management program, or IRAM, its goal was to make better use of existing assets while reducing requirements for replacement and repair. At the same time, the Navy turned management responsibility for thousands of previously organically managed consumable items over to the Defense Logistics Agency. This allowed more direct attention to be paid to the management of repairable items.(7:I-3)

Fiscal Policy. The struggle to further improve the Navy's management ability has continued strongly into the current decade. A recent policy change in the funding of repairable components took place in 1984. Prior to this change, replacement of DLRs was funded through Congressionally appropriated procurement funds. These funds were controlled through the tedious annual budgetary process, which required multi-year lead times for requirement planning and forecasting. This reduced the flexibility Navy comptrollers had in redistributing the money as current-year requirements changed, and meant that the using activity itself had no cost burden to bear for the replacement of their components.(9,13:3-1)

As a result of this condition, the concern for final disposition of non-Ready-For-Issue (NRFI), or "condition F", DLRs among individual using activities was not at its highest. Since it did not cost them anything to request a new item without turning in the old one, they were less likely to take pains to ensure the turn-in got safely back into the supply system.(13:3-1) However, with the 1984 shift in funding policy, the Navy changed the source of funds for DLR repair and reprocurement. Now the issue of repairable components is a Stock Account-managed function. This means that the end-user must requisition each component, and "buy" each DLR.(13:3-2)

To manage this program the Navy has established two prices, "Net" and "Standard", for the replacement of an item. The Standard Price is the actual replacement cost of the component (plus certain surcharges).(2) This amount is billed to the activity when the item is unavailable for turn-in (lost at sea, damaged beyond repair), unaccounted for, or otherwise missing in the supply system. The Net Price, which primarily reflects the cost of repair of an item, is the reduced cost of replacement borne by the activity when the old carcass has been properly turned in to the supply system.(13:3-2) The difference between the net and standard prices is known as the "Carcass Value" and can be as much as 65% of the standard price.(2)

For example, if an aviation squadron requisitioned a new $60,000 radio transceiver to replace a failed one, it would be billed $60,000 if it could not or did not turn in the failed carcass. However, if the Net Price of the radio is $18,000, then the squadron would avoid $48,000 in replacement costs if it properly turned in the NRFI carcass. This cost avoidance can result in huge amounts of unspent money when a year-end total is made for a single ship or aircraft squadron's DLR transactions. A small ship such as a cruiser or frigate might replace 30-40 repairable components per month, while an aircraft carrier, supporting over 80 planes might replace 1200 per month.(11) Thus, from a purely financial aspect, the proper handling of retrograde materials is of great importance.

Additionally, since DLRs now fall under Stock Funding accounting methods, the costs of replacement are billed to the user via the activity's Type Commander. (Commander, Naval Surface Forces Atlantic (COMNAVSURFLANT) is the Type Commander for East-coast ships and COMNAVAIRLANT is Type Commander for East-coast aviation squadrons.) Since the Type Commander for each activity has fiscal management responsibility for his units' operating budgets, he has an obvious interest in overseeing the prudent expenditure of these funds. As a result, he can exert command pressure to induce each unit to accurately and diligently comply with turn-in procedures.(8)

Carcass Tracking. Once turned in to a supply activity, a "condition F" component is tracked by the Inventory Control Points (ASO, SPCC). This is done by the computer program B35, which matches a requisition transaction of a replacement component to the receipt transaction of the failed component. If the requisition document is not matched by a receipt at a DOP or its support center within a specified number of days, the Inventory Manager (IM) initiates a follow-up action to try to locate the missing item. (7:VII-8) This process involves burdensome administrative procedures and results in an increased workload for the IM and the originating activity. Unresolved cases can result in the originating command being billed at the Standard Price.(3)

The management of DLRs is accomplished through the use of Document Numbers (DCN) or Transportation Control Numbers (TCN). While these codes are virtually identical, except for the last three digits of the TCN, their use depends on how the component being managed is viewed. For instance, inventory managers deal with document numbers while transshippers and freight agents deal with TCNs. These alphameric codes identify the component's unit of origin, the date of requisition or shipment, and assign a unit-specific serial number to that particular transaction. The last three positions of the TCN, usually "RXX" for DLRs, indicate that the component being shipped is a repairable and is eligible for priority transportation.

The History of the ATAC Program

Pre-ATAC Retrograde Procedures. Prior to ATAC, the Navy provided procedures for return of retrograde Depot Level Repairables through its normal supply pipelines. These pipelines utilized assets of the U.S. Air Force's Military Airlift Command (MAC), the U.S. Postal Service, as well as Navy ships for transportation of components from both overseas and stateside bases to the various repair facilities. In addition, the Navy utilized its own stateside logistic transportation system, known as Quicktrans, using contracted air and ground freight movers.(18)

The old process for dealing with repairables was as follows. When a repairable component failed, and it was beyond the user's capability to repair, a new one was requisitioned. Normally, the return of the old one was demanded at time of replacement, unless it was required to remain installed until the replacement component arrived. Supply personnel assigned to the using activity looked up the component's stock number or part number in a Master Repairable Item List (MRIL, or NAVSUP Publication 4107). This publication lists, among other things, shipping addresses for the item's Designated Overhaul Point or Designated Support Point (DSP).

The DSP can be the Naval Supply Center (NSC) co-located with the DOP, or it can be a smaller supply department within the DOP. Either way, it performs all of the supply functions of inventory accountability, warehousing, parts support, packaging and preservation, and transaction item reporting (TIR), thus freeing the DOP to perform its industrial functions. For purposes of simplicity, references to shipments to DOPs will omit the stated but implied intermediate destination of the DSP.

The supply clerk was (and still is) responsible for packaging the item for shipment and addressing it to the correct destination. Transportation to the DOP was accomplished through the mails if the item was small enough, that is, containers less than 70 lbs. and less than 108 inches in length and girth combined.(13:8-3) If not, it was delivered to the nearest shore activity for transshipment by the Defense Transportation System.(13:6-1) Although Navy guidelines direct packaging and shipment of unserviceable DLRs within 72 hours of turn-in by the actual user, this was not done. Due to operational commitments, remote or independent missions, or inattention by fleet supply departments, the average time a deployed unit held a non-RFI component onboard was estimated at as much as 14-21 days from failure to shipment.(14) When the item eventually reached its destination, it had been without the benefit of any monitoring or tracking along the way. These procedures allowed many items to be sent to the wrong destination, to be lost, or to be delayed due to careless or backlogged material handling systems. Also, the lack of real-time carcass tracking capability impeded the Inventory Manager's ability to accurately manage its assets.

ATAC Test Procedures. Prior to the ATAC system, the information systems for managing the huge volume of retrograde DLRs could not account for the custody or location of a component on each leg of the shipping process. Components, identified by their DCN or TCN, were only visible at receipt points, such as DSP/DOPs. Even upon delivery the Transaction Item Report, which informed the ICP of the receipt was not always performed. Commercial contracted repair facilities did not always perform TIRs, which left some components invisible to the IM for extended periods of time.(5) As a result, an undetermined number of components were lost, or unaccounted for, and this necessitated replacement buys.

In 1984, the Naval Supply Systems Command started work on a method of further improving the Navy's repairables management program. There was fleet-wide concern that the retrograde time for DLRs was too long. A 1983 Mediterranean Air Logistics Conference, sponsored by Commander, U.S. Naval Forces Europe (CINCUSNAVEUR), and attended by many participants in the Navy's Mediterranean theater of operations, documented that transit times were unacceptably long, and were creating problems for inventory managers. Also, this problem was identified as a recurring condition from the 1976 conference.(4:13)

It became NAVSUP's goal to create a new system using techniques and concepts borrowed from commercial freight carriers, such as Emery Worldwide and Federal Express. The concept of a central processing point for DLRs with overnight transportation to the DOP was born, and in the summer of 1985, a six-month test of this concept was conducted.

A carrier battle group, comprising about 15 ships, was to operate in the Mediterranean using special retrograde shipment procedures. When a repairable component failed, instead of looking up the DOP in the MRIL, and then mailing or shipping the item directly to that DOP, the ships all had pre-addressed labels which directed components to a contractor in Norfolk, Va. In Sigonella Sicily, a major way-station for Navy materials going into and out of the Mediterranean, a contracted freight forwarder received the repairables enroute to Norfolk. He documented the arrival of each component, using its TCN as an identifier, and consolidated the component into cost-effective loads which qualified for lower MAC tariffs. He also booked the shipments on MAC, then entered flight departure data into his computer data bank, and electronically sent this information to the contractor at Norfolk.(11)

Back in Virginia, the contractor met the incoming MAC flight at the Norfolk MAC terminal, and took possession of the shipment. The contractor broke down the load, unpacked each component, performed a technical screen of each item, comparing the item with its accompanying turn-in documentation, prepared appropriate shipping manifests and labels, and repackaged the item for onward movement to its final destination. He then arranged next-day delivery at the DOP via air or ground transportation.(18) A signed receipt at the DOP completed the transaction. All of the different consignment and processing dates and times were electronically documented and this computer data was eventually forwarded to Navy Supply Systems Command for record purposes.

The key to the success of the test program was the short time each item spent in the various phases of its journey. Instead of receiving little attention or low priority handling in the Mediterranean, the components were expeditiously routed on MAC flights to the States. The contractor was to pick up the arriving cargo in Norfolk within four hours of release by the inbound carrier. At the HUB, items were to be processed within 24 hours. The contractor was then expected to receive the processed components and arrange next business day delivery to the prescribed address.

Current ATAC Procedures

The results of this test program were so positive that NAVSUP decided to implement the ATAC system fleet-wide. Three central receiving/processing facilities, or "HUBS", were established in Norfolk, San Diego and Subic Bay, Republic of the Philippines. These HUBs will eventually receive almost all fleet-generated retrograde repairable material.(15) Two freight contractors, currently Emery Worldwide and Burlington Northern (the test contractor), move goods in and out of the HUBs. Burlington Northern still has an agent in Sigonella consolidating, documenting, and booking air shipment. Burlington Northern handles the freight generated east of the Mississippi, and in the Mediterranean and western Indian Ocean theaters. Emery handles the cargo generated in the western half of the United States, westward to Diego Garcia. All traffic arriving in CONUS from the Pacific theaters is delivered by MAC aircraft at Travis AFB, CA.

At this time, the three HUBs are government owned and operated. Existing warehouse facilities were converted into processing centers by the installation of conveyor systems, a computerized MRIL, and packaging/preserving capabilities. The cost of converting Building SP-237 at the Norfolk Naval Air Station to an ATAC HUB was about $900,000.(3) This sum will be recouped in the ensuing years as ATAC's effectiveness is refined, and greater cost avoidance and savings are realized.

The phased implementation of the ATAC system is currently still progressing. As more Navy installations join the ATAC system, the production levels at the HUBs increase. Although the number of items processed monthly by the three HUBs is growing, a Navy-wide civilian personnel hiring freeze imposed by the Secretary of the Navy inhibits the facilities from meeting the goal of one-day processing through-put. The Norfolk HUB's output has grown from close to 16,000 items per month in October 1985, to over 33,000 items in July 1986.(1) Although a limited waiver of the hiring freeze has allowed the recruitment of 25 more employees for the Norfolk HUB, to date they have not started work. This has caused a five-day backlog of unprocessed repairables.(1)

In addition to movement of components to and from the air terminals and processing facilities, the contractors are also performing local movement of HUB-bound material at various stateside locations. For example, a Burlington Northern agent in Mayport, FL picks up freight from pierside ships and the Ship Intermediate Maintenance Activity (SIMA) and consolidates it for overnight shipment to the Norfolk HUB. Similar actions are performed at naval stations in Pensacola, Norfolk, Virginia Beach, Jacksonville, and San Diego.(18)

Future Plans

The schedule for full fleet implementation was designed for completion by 1987. These plans include more processing facilities in Japan and Diego Garcia. Also included are intentions to expand the scope of the ATAC concept to include out-bound RFI material. This expansion will make ATAC an important management tool in both the issue and retrograde arenas and will significantly enhance spares availability. However, the effects of the recent Gramm-Rudman-Hollings Law and the resultant federal budget cuts have affected the planned implementation.(12) Establishment of more overseas HUBs will be delayed because of this. Nonetheless,it does appear that stateside implementation will be completed by the end of FY86.(8) Future goals also include exploitation of technological improvements in bar coding and voice recognition computers to reduce keystroke data inputs. Longer term plans include possible sharing of ATAC concepts among the other Services.(14)

Current efforts include development and implementation of a fleet awareness program, to further increase the emphasis on and concern for the proper handling of repairables.(12) There has been a mind-set in the fleet, among those not closely involved or educated in supply functions, that retrograde items are not worthy of high priority or interest.(17) Among the actual users, concern for RFI replacement items is much greater than concern for the equally important retrograde pipeline. While this attitude is understandable, it is based on a lack of information, and a poor appreciation of the retrograde system.

To try to alleviate this condition, NAVSUP is drafting an instruction for all fleet units, which will offer basic guidance about the ATAC system and its procedures.(11) In addition, one of the more significant efforts is a program to reduce fleet turn-in times. NAVSUP is accumulating a huge data base on the retrograde shipping performance of all Navy units using ATAC. This data base can extract a historical, quantitative summary of the retrograde times of a specific unit or installation over a given period of time. This information will be available to individual commands or to any level of the chain of command.(11) It is hoped that the availability of performance assessments will identify problem areas and motivate individual units to improve their records. The availability of such information to Wing, Force, and Fleet level commanders has obvious implications in the continuing effort to make the Navy an efficient and cost-effective organization.

The information which will make up this data base will be the same information recorded by the contracted freight agents as part of their service agreement obligations. These records will be forwarded to NAVSUP periodically, for inclusion and updating of the data base. NAVSUP's goal is to reduce the time between the requisition date and the first visibility of the "condition F" repairable at a processing HUB to no longer than 20 days.(11) Successful efforts to further improve fleet performance in retrograde handling will significantly enhance the Navy's inventory management capability and ultimately improve readiness.

Summary

The decision to go with ATAC was made by senior members of the Navy's chain of command. It was based on the success of the trial run conducted in 1985. Although the length of the retrograde pipeline under the ATAC system is currently very well documented because of the improved information systems, the old data does not reflect how long return times used to be. That information was not captured in an easily useable form prior to ATAC. Current study by NAVSUP and NAVMTO is being conducted to further document the true cost-effectiveness of ATAC.

III. Methodology

Research Study Design

The design of this research project will be developed based on the four research questions stated in Chapter I. These four questions, if answered, will provide a solid framework for evaluating the effectiveness of the ATAC system. Although each question may not always be answerable in completely quantitative terms, sufficient qualitative evidence is available to justify the study findings.

Question 1 Are there differences in pre- and post-ATAC transit times from overseas points to the U.S.

Question 2 Has ATAC reduced in-CONUS transit time to the depot?

Question 1 will be investigated under the assumption that the ATAC system should show reductions in transit time from overseas stations because of priority handling by the Subic Bay HUB and by the Burlington Northern and Emery agents in Sigonella, Sicily and the Philippines. It is theorized that the elimination of excessive port-hold time at the overseas freight terminals and expeditious handling upon arrival in the U.S. should reduce overall transit times a significant amount.

Question 2 will be investigated under the assumption that contractor-moved components reach their destinations from stateside shore stations in a faster manner than would those moved by the U.S. Postal System or the Navy's organic air transport system, Quicktrans. If this proves to be true, then it is hoped that the shipping records will substantiate this assumption and validate the effectiveness of the ATAC system.

Since Questions 1 and 2 both deal with the possible improvements in travel time for DLRs under the ATAC system, they will be investigated using similar methods. The mean transit times, from component failure until its arrival at a repair facility, will be determined using both pre- and post-ATAC shipping data. This comparison of means will be tested at a 0.05 level of significance, and used as a basis for conclusions about the ability of the ATAC system to actually reduce shipping time.

<u>Question 3</u> Has ATAC affected the processing requirements of the DLRs at the repair depot, and if so, how has this affected the time period from depot delivery to induction into repair?

Because the HUB facilities perform technical screening of each item as it is processed, this task should no longer be required of the overhaul facility or the supply facility which serves as its DSP. This screening entails a verification of the information included on the turn-in document, DD Form 1348-1, and a matching of the actual component with its maintenance documentation. If this process is performed more quickly and accurately by the ATAC HUB, then the time and effort savings should allow quicker repair of critical items. This issue will be explored through telephone conversations with various agencies involved in repairable components. It does not lend itself to quantitative analysis, and will be discussed in a narrative, based on the results of the interview process.

Question 4 What is the significance of any changes in the transit time that are a result of the ATAC program?

The answer to this question will represent the subjective evaluation of the findings of Question 1, 2 and 3. The method of evaluating the quantitative results of this study will require interviews with several agencies directly and indirectly involved with the ATAC program and other Navy supply issues. It will also be discussed in a narrative form in the following chapter.

Data Sources

The data bases used will include Transaction History Files and B35 files (carcass tracking records) from the Aviation Supply Office, as well as transshipment records from Emery Worldwide. Where possible, the data from separate time periods reflective of pre- and post-ATAC system will be used. In addition, interviews with numerous experts in the area of repairables management will provide the information which guides the analysis of the quantitative data. Most of the subjects are current or former Department of the Navy employees from ASO, NAVMTO, NAVSUP, and NSC NORFOLK.

IV. Data Acquisition

Chapter Overview

This chapter presents a summary of the efforts involved in the acquisition of the data bases and information used in this study. It is included to increase the reader's appreciation of the difficulties and constraints involved in this study. The chapter outlines the various phases of the search for useable supply data for use in the study and describes the sources of this information.

Field Visits

Washington. Initial efforts into this research project necessitated an extensive short-term education in the areas of repairables management and Navy physical distribution systems. The former subject required a visit to the Naval Supply Systems Command in Washington DC. This visit included an introduction to the members of the Repairables Management Division (NAVSUP Code 06), who oversee the implementation and monitoring of the ATAC program. One-on-one interviews with the ATAC project managers produced valuable insight into the history of the ATAC program and its future implementation. This one-day visit, while brief, provided specific direction and assistance towards the design of the research project. At the same time, it led to the establishment of a strong working relationship between members of NAVSUP and the author.

Norfolk. Based on recommendations made during the visit to Washington, a funded visit to Norfolk VA was arranged in February 1986. The main purpose of this trip was to gain insight into the NAVY's transportation systems, as well as into its supply systems. This was achieved following a full day of interviews with numerous members of the Navy Material Transportation Office. These interviews provided information on the transportation systems involved with ATAC, and the differences in pre- and post-ATAC material distribution methods. Briefings on billing procedures, industrial funds, and current ATAC cost analysis were conducted. In addition to the NAVMTO indoctrination, an interview with a repairables management expert at the Norfolk Naval Supply Center, was arranged. The result of this interview left little doubt as to the difficulty of extracting retrograde time data from existing Navy supply data, something that was also confirmed by experts at NAVMTO.

Also included during the trip to Norfolk was a tour of the Norfolk HUB. Building SP-237 on the Norfolk Naval Air Station is quite an unimpressive looking edifice. As an old warehouse, its exterior boasts nothing of modern construction. Yet, the interior is fully equipped with a complex maze of freight handling conveyors, computer terminals, component packaging stations, and what seems like an avalanche of unserviceable retrograde DLRs. Crates in various states of proper packaging and labeling, stray individual components, and an endless supply of sealed boxes of all sizes crowd the freight reception area before being loaded according to size on the electric conveyors.

As each component was shuttled past a computer operator, it was logged-in according to document identifier, stock number, price, quantity of issue, condition, and other item variables. This information is usually already included on the DD Form 1348-1 which accompanies the item. The computer processed this input in seconds, and by referencing the Master Repairables Item List stored in its memory, it was able to identify the correct DOP for the item, and also print out a mailing label for the item. This total transaction takes only a few seconds and allows hundreds of items to be processed in a single day.

After being receipted by the computer operator, the component travelled along the conveyor to the packaging station. Here, employees packed and boxed the component for safe shipping and storage. (Although some items require rather extensive and expensive chemical preservation or desication, and container pressurization for full environmental protection while in shipment or storage, current funding levels do not permit this.(1) Items are only packed at Level C specifications which are used when known shipping conditions are favorable.(13:7-2) The box was then appropriately labelled, addressed, and removed to the loading dock for shipment to its final destination.

The commercial contractors picked up the sorted and palletized freight at the loading dock. It was at this point of consignment that the contractor started the "next business day delivery" race in order to get the components to their final destination.

Pre-ATAC Data Requirements

In order to determine the length of the pre-ATAC retrograde pipeline, some quantitative data records which describe this period were necessary. Because the Navy did not have easily manipulable forms of data which could address this issue, (short of using expensive computer resources to access them) it became apparent that this would not be a simple requirement to fulfill. Existing supply records did not document DLR repair cycle time in terms of transportation time. Therefore, extrapolation of data from a more comprehensive data bank was necessary. The Repairables Management Branch at Naval Supply Systems Command recommended the use of Transaction History Files (THF). This form of data was suggested because it was readily available in microfilmed format, and did not require expensive or time consuming computer resources to access. In the interest of expediency, the THF records were deemed the most feasible, and in truth, seemed to be the only records available to meet the time and cost constraints of this project. Several other options involving access to Navy Supply Centers not currently using ATAC procedures, or requiring computer resources were rejected as impractical, given the aforementioned time and money constraints.

In compliance with a request from NAVSUP, the Aviation Supply Office (ASO), in Philadelphia supplied a full year's collection of Transaction History Files from calendar year 1984. A transaction history is a computer-generated and stored collection of supply data for a one-year period. These files list every supply transaction reported to ASO. These transactions include issues, receipts, transshipments, losses, condition code changes, and the like.(2) Essentially, it is an alphamerically coded history of all the aviation-related items used or otherwise processed by the Navy (and managed by ASO) in a given year. It is structured in a 120 card-column, single line entry format. Each of various card-column segments contain bits of information, most of them corresponding to standard Department of Defense material issuing requirements. A sample page of THF data with a description key is located in Appendix B.

Unfortunately, due to limited computer support from ASO, it was not possible to receive the THF data in the form of a computer tape. Had this been possible, the tape could have been processed by AFIT computer resources, permitting a more comprehensive and timely investigation of the transit times. In any case, it might have precluded the manual extraction of data from the cumbersome format of the microfiche, even if only by providing a more manageable hard copy printout.

The THF data was delivered however, in the form of 895 sequencially numbered, 3 x 6-inch sheets of microfiche. Each sheet of film contained 15 rows of 18 pages, or 270 photographed pages of data records. As Appendix Billustrates, each individual THF page contains 55 separate supply transactions. Thus, the data base for the pre-ATAC retrograde pipeline included some 13,290,000 inventory transactions. Note that of this total number of transactions, only a fraction were of relevance to the study. On a given page of data, anywhere from 0-30% of the transactions involved repairable components returning to a repair depot. Thus the total population of relevant repairable transactions is estimated at closer to 2 million.

Data Sampling Methods. Obviously with such a huge population to investigate, a sampling plan was needed to reduce the number of transactions researched. Based on the sequentially numbered structure of the files, it seemed that a systematic sampling plan would prove sensible. With this approach, every kth element of the population is sampled, beginning with a random starting element from 1 to k.(10:305) This sort of plan would provide a random sampling of the entire data base and still include a full cross-sectional sample of the whole year's data record.

While a randomly generated selection of numbers from 1 to 895 would have provided the most random sample, this method could not have guaranteed that a reasonable sampling of the entire data-year was achieved. It was assumed that a full cross-section of the data films was important because it could account for any seasonal or cyclical tendencies in the shipment or usage of the repairable components. (For example, during the Christmas holiday season, more deployed ships are in port and have better logistical support than when underway. These sort of inconsistencies might skew the data somewhat.) As was later discovered, the THF data was organized by sequential National Item Identification Numbers (NIIN). Thus, the concern for integrity of the data-year was unnecessary.

Therefore, starting with sheet 10, every 10th sheet was pulled from the original 895. This method of random selection reduced the number of data films to 89. With this more manageable number of microfiches, the retrograde-time samples were gathered via the method described below.

Data Extraction. The next process involved the actual extraction of data from the microfilmed records. This required that the films be viewed on a microfiche reader. Unfortunately, no automated method of data extraction was available, so each sheet was placed in the viewer, individual pages were focused, and then searched for document identifiers which indicated repairable component transactions. These were indicated by a "D6K" or a "D6A" in the first three card-columns, such as the first two transactions in the sample page in Appendix B.

Once located, the transaction contained a 14-digit document number in card-column 30-43. The document number reflects a 6-digit Unit Identification Code, a 4-digit julian date, and a four-digit serial number which catalogs each transaction. The embedded julian date in columns 36-39 was the first object of attention, as it reflected the requisition date of a replacement for the failed component in question. For the purposes of this study, the date of requisition of a replacement and the date of component failure were assumed to be the same day. This date was also assumed to be the date the component was available for shipment. Whether it was actually shipped on that day is dependent on several factors.

The next bit of information needed was contained in columns 73-75. This number is also a julian date, which reflected the day on which the DOP transmitted its Transaction Item Report (TIR) to ASO. Essentially, it is the date that the failed component was received by the depot for repair. Thus, the length of time between the requisition date and the TIR date determines the length of the retrograde time. This was easily deduced by subtracting the first date from the second. For example, a document number of "N058385252A781" and a TIR date of "295" in columns 73-75 indicates a transit time of 295 minus 252 equals 43 days. This method of data extraction was repeated manually for a sample of 900 transactions.

As the huge number of component transactions on the 89 films became apparent, it was necessary to reduce the number of microfiches surveyed. This required altering the sampling plan. This was done by starting with the 10th sheet, and then taking every 100th sheet thereafter to reduce the number of sheets to a total of 8. This still reflected some 100,000 transactions, of which, perhaps 15% were D6K or D6A transactions. This sample data base of 900 entries was written into a computer file for evaluation. It was then processed using BMDP software packages for statistical analysis.

ATAC Data Requirements

ATAC Data Selection. To draw a valid comparison between pre- and post-ATAC shipping times, similar data describing the ATAC transportation process was needed. Fortunately, this kind of information was more readily available and in a much more accessible format. Fairly recent carcass tracking records documented by Emery Worldwide during their handling of Navy DLRs were available from the Naval Supply Systems Command. NAVSUP provided a 5 1/2-inch floppy diskette which contained 1700 records. Each record detailed the shipment of an individual DLR from its arrival at the HUB to its delivery at the DOP. This data was formatted in "dBASE II", a commercially produced data base management software. A sample data page with record key is reproduced in Appendix C.

A review of Appendix C reveals that the data included for the ATAC shipments is much more detailed and comprehensive than that of the Transaction History Files.

This is predominantly because the data base is maintained by the contractor (in this case, Emery Worldwide) as a requirement of the service agreement. Also, because of the very nature of the ATAC system, accurate carcass tracking is not only feasible, but mandatory.

ATAC Data Extraction. It was originally hoped that the use of the computer spreadsheet would invite several avenues of data exploration. Investigation into the average length of time a component spent in the HUB, in the MAC system, and in transit overall was to be the original method of analysis. Unfortunately, the format of the data precluded this rather substantial undertaking.

As can be seen in the Appendix C, the data accounts for a component's entry into and exit out of the HUB, and the MAC system, by recording the julian date of each consignment. But the format of the julian date entries on the spread sheet records each number as a "label" or character string. This means that the computer does not read "5031" as a number which implies January 31, 1985, but as a word or symbol. Therefore, subtraction of one date from another via the built-in mathematical abilities of the dBASE program was not possible, because the software will not perform arithmetic operations on non-numeric data elements. Thus the subtraction of the into-MAC date from the out-of-MAC date, which would determine the actual time a component spent in the Air Force distribution system, was not feasible using the automation of the software. Needless to say, this proved to be extremely frustrating and constraining.

Because the dates of each separate consignment of the component were not electronically manipulable, it became necessary to reduce the scope of the ATAC data analysis. Instead of an investigation into the length of each leg of the transshipment, only the overall retrograde time was evaluated. This derivation was performed in a similar fashion as was the pre-ATAC transit baseline. The embedded julian date in the Transportation Control Number in Column A was subtracted form the date of delivery at the DOP, in Column J. This arithmetic operation was performed on all of the component transactions which had a Proof-of-Delivery date in Column J. Unfortunately, even the data supplied on the floppy disk was incomplete, with several hundred data elements missing from the 1700 transaction records. This posed no serious problems, as only those records with entries in Columns A and J were included in the analysis. However, this perforated data base did reduce the total number of records which could be investigated.

The final step of the data processing was the loading of the transit time values into a spreadsheet for analysis. This was done with the "VIP Professional" software, another commercially available business management product. This spreadsheet allowed calculation of the mean and standard deviation values.

ASO Computer Analysis

Well along into the research process, the Repairables Management Division of the Aviation Supply Office in Philadelphia volunteered to provide a limited computer analysis using their own data files and computer resources. This offer was eagerly accepted, and NAVSUP coordinated the data parameters which would be used to conduct the analysis. NAVSUP proposed searching the repairable component history records of seven specific Navy units to compare DLR turn-in times during two specific time periods. The time periods were from 2 April-31 December 1985 and from 1 January-12 March 1986. The individual commands were five East-coast aircraft carriers (USS Forrestal, Eisenhower, Nimitz, Coral Sea, and Saratoga), and two shore supply centers at Pensacola FL and Jacksonville FL.

ASO ran a computer program called "FOCUS", which searched the carcass tracking data files of each of the seven commands and extracted the requisition date of a replacement component and matched the receipt date of the failed component at the DOP. This process was essentially the same method used to derive the retrograde time data bases previously discussed. This method, however, had the distinct advantage of being able to compare transit times of individual commands. Also, the capabilities of these computer resources allowed a search of the entire data file for the periods covered. This permitted extraction of over 3416 total turn-in times, easily eclipsing the 1200 or so which were manually extracted.

ASO provided a hard copy printout which listed each transaction by document number, NIIN, number of observation days (retrograde time), and the component receipt date. This hard copy listing of 3416 data entries in 10 separate files was then written into separate computer files on either the AFIT Scientific Support Computer or on a commercial computer spread sheet. This allowed further calculation of mean and standard deviation values.

For unknown reasons, the data search of the two shore stations at Pensacola and Jacksonville did not yield any results. There was only one single entry for the 1986 data for NSC Pensacola, and none for either installation in the 1985 period. The search of the USS Eisenhower's data records did not yield any data for the 1986 period either. Although this was a perplexing occurrence, the data analyst at ASO could not account for it. Because the FOCUS programming is rather time consuming and in fairly high demand at ASO, there was no request for any rerun of the original data search. The original FOCUS computer run was an act of personal goodwill and any complaint as to its completeness or quality was certainly unjustified.

V. Analysis of Findings

Pre- and Post-ATAC Data Comparisons

Table I below shows a summary of the data derived from the manual manipulation of the two data bases previously discussed. Table I displays the mean transit time, standard deviation, range, and size of the sample taken from the 1984 Transaction History Files. These numbers represent a pre-ATAC aggregate data sample of aviation-related repairables processed in calendar year 1984. Table II shows the summary of data derived from the ATAC shipment records collected by Emery Worldwide. Again, the mean transit time, standard deviation, range, and size of the sample are shown. The significance of these parameters will be discussed below.

TABLE I

Transaction History File Data (1984)

MEAN VALUE	49.9 days
STANDARD DEVIATION	61.2 days
SAMPLE SIZE (n)	900
RANGE OF DATA	1-383 days

TABLE II

ATAC Data from Emery Worldwide (1985)

MEAN VALUE	34.4 days
STANDARD DEVIATION	28.3 days
SAMPLE SIZE (n)	333
RANGE OF DATA	9-221 days

Sample Size. As was previously discussed, the sample size of the Transaction History Files was limited to 900 cases. This sample size out of a population of perhaps 1.3 million may seem rather small. However, based on the time and labor involved with deriving each transit time element from the cumbersome format of the microfiche data base, the total number of transactions sampled reflects a considerable expenditure of effort. Statistical analysis of the sampled data indicates that a sample size of 900 yields an estimated error of ± 4 days. This is certainly acceptable given the huge range and variance of the data.

The limiting factor in the sampling of the ATAC data supplied by Emery Worldwide was the construction of the data base itself. As was previously mentioned, there were hundreds of data elements missing from the diskette acquired from NAVSUP. Only a total of 333 transaction records listed a delivery date at the DOP. According to NAVSUP, these holes in the data were the result of misunderstandings between the government and the contractor concerning data recording responsibilities and requirements. This attribution to "growing pains" is understandable, as the diskette reflected information captured in the earliest months of the ATAC operation. According to the ATAC project manager at NAVSUP, this condition has been corrected and is no longer a problem.(11)

Range of Data. This parameter is probably the hardest to completely account for. In each of the two data bases sampled, the range of shipping times is quite wide. The low values are easily accounted for as they probably reflect items moved from a unit or activity to a nearby DOP or DSP. This sort of transaction is quite possible when the repair sites are co-located at operational installations, such as the Naval Air Rework Facilities. In these cases, it is possible that hand-delivery or local mail can route DLRs within 5 days.

However, it is not the low values which are of real interest to this study, or to the Navy in general. The presence of very high values of 200 days or more is more difficult to account for. The primary explanation is that these values represent items which failed on day 1, but because of their structural or functional characteristics, were required to be left installed on the parent system. These "Remain in Place" items were finally removed for shipment when a replacement arrived and was installed. It is not unlikely that, for some non-critical components, a long period of time can elapse between failure and shipment. As a result, the time the item remains installed before shipment is included in the period studied.

Other reasons exist for surprisingly high values in the data. Items which are misplaced in the command, or not turned in when replacement items are requisitioned can account for excessively long periods between requisition and TIR dates.(3) These items may not be found or turned in until a carcass follow-up message is sent to the command, requesting the location of an item which has not been accounted for. This kind of poor supply management is one of the key areas which the ATAC system is designed to improve. Another reason is that the transaction information may somehow get scrambled in the transmission of carcass tracking data, while the actual component may have been properly handled and processed.(3) Such mistakes in the data keeping do occur and reconciliation delays would be reflected in the transit time period as defined in this study.

As noted previously, since the only way to determine the retrograde time was to assume the date of requisition was the date of shipment (give or take 3 days), there was no way to tell whether the item was actually shipped within a few days of failure, or remained in place for considerable time. As a result, the possibility exists that some items could theoretically have remained installed for several months, and then been shipped to a DOP within a reasonable time. Equally true is the possibility that an item was shipped expeditiously to its repair site, yet the paperwork documenting the transaction was inaccurate.

Despite the implications of such a possibility, there is no real need to invalidate the study. In most of the data surveyed, the percentage of components which had excessive transit times were small. For example, in the Transaction History File data, the maximum value observed was 383 days. Yet, only 5% of all the THF components investigated had transit times of over 180 days. And only 20% of the data had times of more than 72 days. Similar investigation of the Emery ATAC data reveals only 3% of the times in excess of 100 days.

Thus, the wide range of values for the length of retrograde times is certainly worthy of notice, as the excessive time can skew the mean values of a given data set. For example, when the highest 5% of the transit times from the Transaction History Files was removed from the data base, the mean transit time was reduced to 38 days. This represents a fairly significant reduction. However, since all of the data bases investigated included even the highest values, consideration of removing such obvious outliers was abandoned. Also, the small number of items affected by such anomalies renders them less significant.

Mean Values. In the comparison of transit times between components shipped under the ATAC system with times of items shipped via previous systems, the true test is the relationship of the mean shipping times. As is evident from Tables I and II, there was an apparent 14.5 day difference in the transit times. The difference in the mean values was verified statistically at a 95% confidence level. The confidence interval for the difference in the means was 14.5 ± 4.2 days. This implies that we can be 95% confident that the ATAC data showed a 10 to 19 day reduction of the average time from requisition to arrival at a DOP. The implications of this difference in mean transit time will be addressed later in this report.

ASO Computer Analysis

A summary of results of the computer analysis conducted by the Aviation Supply Office is included in Table III. This analysis was a search of the carcass tracking records of five aircraft carriers over two separate time periods in 1985 and 1986. These periods reflect pre-ATAC and post-ATAC repairables processing respectively. The computer survey extracted the time from requisition date to DOP receipt date for all completed repairables transactions within the stated periods. From these listings of transit times, mean values and standard deviations were calculated. The data parameters are discussed below.

TABLE III

Summary of Aviation Supply Office Computer Search

Period: 2 April-31 December 1985

SHIP	CV-43	CV-59	CV-60	CVN-68
MEAN SHIPPING TIMES	43.6	80.0	41.6	44.9
STANDARD DEVIATION	50.8	83.0	40.6	42.5
SAMPLE SIZE (n)	434	45	741	824
RANGE OF DATA	2-430	12-222	2-299	2-441

Period: 1 January-12 March 1986

SHIP	CV-43	CV-59	CV-60	CVN-68
MEAN SHIPPING TIMES	32.2	50.1	47.5	55.5
STANDARD DEVIATION	29.0	36.0	27.6	13.0
SAMPLE SIZE (n)	241	76	602	27
RANGE OF DATA	3-245	6-135	6-174	31-92

Sample Size. The sample sizes for each of the ship surveys were determined by the number of completed carcass tracking files included in the ASO files. The numbers do not necessarily represent the exact number of repairables shipped by each command in the period stated. This is especially true for the January to March 1986 period, because there might have been transactions initiated, which for various reasons, did not have fully completed files. Thus, the sample sizes were limited by the number of completed records in the ship's history files.

Range of Data. Not unlike the data from the aforementioned Transaction History Files and the ATAC shipping records, the range of shipping times in the ASO information was also broad. Again, this was reflective of the many variable factors which can increase the retrograde time of DLRs. It was also due in part to the method of determining the transit times. Because of any number of reasons, the period described by the difference between requisition date and TIR date does not always truly account for the actual transit times. However, given that this limitation was unavoidable, and was similarly applied across all of the data bases used in this study, this inaccuracy was considered acceptable for the purposes of this study.

Mean Transit Times. In an attempt to evaluate the possible effects of the ATAC system on shipment times, it is reasonable to try and compare mean shipping times of individual commands over two time periods. This has been done, as evidenced in Table III. Unfortunately, the comparison between the 1985 and 1986 data in this case was not as simple as that conducted with the Transaction Histories and the Emery data. In the case of the aircraft carrier's retrograde performance, there were more variables which complicated the analysis.

The primary confounding variable was the deployment status of the ship during the periods of study. To say that the transit time of a given DLR would be the same whether the originating command was pierside in its homeport, or at sea in the Indian Ocean is sheer folly. Yet quantification of the difference in transit times caused by the ship's operational status and geographic location was not, by any means, a simple task. Too many variables influenced the transit time to safely quantify this alleged difference. Availability of supply ships (oilers, combat stores ships, ammunition ships, etc.), frequency and location of port visits, availability of ship-to-shore air logistics support (COD, VOD) services, and operational tempo are just some of the more recognizable factors which drastically influence the transit time of repairable components on their way back to a stateside depot. While the deployment status of each ship was a known variable, the magnitude and even the direction of its effect on mean transit time was a matter of conjecture. As a result of this incomparability of data bases, each carrier's data will be discussed individually, in broad terms.

Carrier Data Analysis

USS Coral Sea (CV-43). As Table III indicates, there was an apparent 11.2 day reduction in transit times for components shipped via the ATAC system. Statistical analysis produced a true difference between the means, of 11.2 ± 6 days at a 0.05 level of significance. This difference seemed to indicate that repairable retrograde time decreased between 5 and 17 days for items shipped from the Coral Sea.

The ship was deployed throughout the full 1986 period and during the last three months of 1985. This seemed to suggest that even though the command shipped components from homeport for 6 of the 9 months of the 1985 period, the average transit time was still shorter when it was deployed in the Mediterranean Sea. No further conclusions could safely be drawn given the limited depth of the data analyzed. This comparison is not ironclad proof of the effectiveness of the ATAC system by any means, but it does suggest possible improvement in the retrograde pipeline since inception of the ATAC program.

USS Forrestal (CV-59). A comparison of data in Table III indicated an apparent 30-day decrease in retrograde time for the Forrestal during the ATAC period. Calculation of a confidence interval at a 0.05 level of significance revealed a difference in mean transit time of 30 $\pm$ 25.6 days. The width of the confidence interval was rather considerable, spanning 4.4 to 55.6 days. Statistically, this still indicated a difference in the mean values, as the interval did not include 0. The wide range of the confidence interval was due primarily to the large variance of the data extracted from the 1985 files of the Forrestal, as well as the fact that there were only 45 records sampled. The combination of small sample size (n) and high variance yielded a very wide interval at a 95% confidence level. Nonetheless, the statistical weakness of the data did not repudiate the fact that there appeared to be a rather sizeable difference in retrograde time.

In both periods, the Forrestal was essentially homeported in Mayport FL. Although she was underway for pre-deployment work-ups during the 1986 period, for the purposes of this study, this could still be considered non-deployed due to the short duration of the underway periods and to the relative proximity to competent logistic support facilities along the eastern seaboard and in the Puerto Rican Operating Area. Here, as in all the cases, the true effect of the operational status of the ship during the data period was unknown. In any event, the mean time of transit appeared to have been reduced during the ATAC period.

USS Saratoga (CV-60). The apparent differences in mean transit times for the Saratoga showed a 6-day increase over the two periods. As before, the derivation of a confidence interval was necessary to determine with any certainty the true difference in mean transit times. Calculations revealed that the confidence interval was equal to 5.9 ± 7.7 days. Because the interval included zero, there was not statistical evidence to support the claim that there was a difference in the mean values. Although the mean values indicate a 6-day increase, given the variances and sizes of the two data bases investigated, this difference was not statistically validated.

As for the influence of the ship's operational status, there was no clear evidence one way or the other. In the 1985 period, the Saratoga was in the Mediterranean. During the 1986 period, she was in Carrier Overhaul (COH), which is an extensive upkeep program in a shipyard. One would expect that the mean transit times would show a decrease while a ship was restricted to a fixed stateside location. Obviously however, the data tested here did not indicate that this was the case. Further speculation on this matter, was of little value given the depth of the investigation.

USS Nimitz (CVN-68). Data analyzed from the Nimitz's carcass tracking files indicated an apparent 10.6-day increase in shipping time. Verification of this difference with a 95% confidence interval yielded a 10.6 ± 5.7 day increase. Thus the data showed an average 5-16 day increase for repairables transit time over the two periods. Of interest in this case was the fact that the 1986 period yielded only 27 completed transactions. Thus, the data sample extracted from the 1986 ASO files may not have yielded as accurate a mean value as did the 1985 data with its impressive sample size of 824. This alone was no reason to invalidate the calculated difference, as a larger sample might have yielded an even greater increase in the transit time.

The Nimitz data was of particular significance because the ship was one of the units used during the 1985 Mediterranean theater test of the ATAC system. As such, the comparison of its 1985 history with 1986 data was not a comparison of pre- and post-ATAC data bases. In essence, both were ATAC data bases, although the 1985 data reflected the earliest operations of the ATAC system. Thus, the comparison of the two means was of questionable value in evaluating the effectiveness of ATAC.

What was of interest however, was the fact that the Nimitz was in a Selected Restricted Availability (SRA) status during the 1986 period. This normally means that a ship remains in homeport and conducts upkeep and maintenance but does not undergo extensive repair operations. This might lead one to expect a lower mean retrograde time than was reflected in the 1985 at-sea period. Unexplainably, this was not the case. Despite being homeported for the 72 days of 1986, the mean retrograde times were still slightly longer. The sample size, however, does meet expectations, with only 27 DLR transactions completed in the 72-day period. This is substantially lower than the 1200 per month an operating carrier might process.(11) The low number presented in this case was due to the absence of the embarked airwing while the ship was in port. As common sense suggests, the 80-plus plane airwing accounts for most, if not all of the usage of aviation DLRs originated in Nimitz.

VI. Conclusions and Recommendations

Implications of the Data

The data bases which were manipulated according to the discussed methodologies certainly have inherent weaknesses and inaccuracies. The "transit time" variable which was extracted is not without ambiguity, given the unknown and unmeasurable factors which determine the length of time a component spends between its originator and the depot. Yet, while accepting these limitations, it is still possible to draw some general conclusions. Table IV summarizes the findings of the data analysis. It will be used to support answers to the research questions asked in Chapter III.

TABLE IV

Summary of Data Analysis

Data Comparison	Apparent Results
Transaction History vs. Emery ATAC data	14.5 ± 4.2 day decrease
Pre-and Post ATAC Carrier Retrograde Avgs.	
USS Coral Sea.	11.2 ± 6.0 day decrease
USS Forrestal.	30.0 ± 25.6 day decrease
USS Saratoga	no significant difference
USS Nimitz	comparison not applicable

Question 1 Are there differences in pre- and post-ATAC transit times from overseas points to the U.S.

Question 2 Has ATAC reduced in-CONUS transit time to the depot?

These two questions had to be considered jointly because the data used in the analysis did not permit separate consideration of overseas and stateside retrograde. Nonetheless, the overwhelming evidence produced by the study seemed to allow a positive response to both questions. ATAC does appear to have reduced transit times for repairables shipped from both deployed and homeported units. The total difference in transit time is difficult to quantify because the pre-ATAC baseline periods were of different length in each case studied.

Also, because the contractors are picking up HUB-bound material at stateside naval installations, there is not as much need to rely on the U.S. Postal Service to deliver the components within CONUS. Components are being consolidated and shipped on Quicktrans directly to the Norfolk and San Diego HUBs on a daily basis. This rapid delivery virtually guarantees that components moved via ATAC arrive sooner than those moved via conventional supply modes.

The predominant results indicate a significant reduction in retrograde time for the data bases investigated. This seems to rather strongly suggest that the ATAC system is effective in reducing retrograde time. It cannot be unequivocally stated that the apparent reductions shown above are all directly caused by the improvements in retrograde movement procedures initiated by the ATAC program. It can be assumed that some of the differences might be attributable to factors independent of

ATAC, such as change in command or departmental awareness, personnel changes, or improved logistics support unrelated to ATAC.

<u>Question 3</u> Has ATAC affected the processing requirements of the DLRs at the repair depot, and if so, how has this affected the time period from depot delivery to induction into repair?

This issue had a dichotomous answer due to differences in viewpoints of the respondents. According to managers at the Norfolk HUB, the full technical screening performed on items received at the HUBs precludes the depots from having to perform this task.(1) This condition allows the depot to receive an item fully identified and prepared for induction into repair, which in turn, reduces the time and man-hours the depot invests in processing a given item for repair. The actual time savings was estimated to be approximately 1.5 days.(3) This difference changes the entry time at the DOP from an estimated average of 6 days to about 4.5 days. These reductions in resource investment therefore reduce the production costs involved with repairing a DLR.(3)

The other side to this question was expressed by NAVSUP and later agreed to by managers of the Norfolk HUB. Because of the enormity of cataloguing the thousands of items managed by the Department of Defense, and the Navy, a complex component identification system, using National Item Identification Numbers (NIIN) and Federal Stock Numbers

(FSN), has been developed to categorize and identify repairable components. Due to the intricacies of this numbering system, it is fairly easy to mistake a similar, but not identical component, for another of like function and form. This misidentification causes problems at a repair depot when an item is inducted into repair and is discovered to be something other than expected. The misidentified component must then be re-identified and rescheduled for repair or stowage. This mistake consumes time and man-hours thereby lengthening the repair turn-around time and increasing the cost of handling.

Because of frequent instances of misidentification in the early months of ATAC operation, some depots were forced to rescreen components arriving from the HUB. Error rates at the Norfolk HUB ran as high as 18% of components processed.(3) This excessive rate forced the DOPs into adopting a policy of 100% rescreens. Thus, the inherent advantages of having the HUB perform full technical screens were lost. Recent improvements, however, in HUB performance has lowered the Norfolk error rate to approximately 2%.(3) Unfortunately, some depots have not fully recognized this improvement and are still rescreening a large percentage of the components. The cost-effectiveness of this rescreening is questionable, as the misidentification rates have been reduced to acceptable levels.(3) Current negotiations between NAVSUP and several of the repair depots should solve these differences in perception.

On the other hand, there are many instances where certain administrative errors perpetrated by fleet units have been corrected by the HUB screening process. These corrections have precluded an item from arriving at a DOP with flawed documentation. When this occurred previously, the DOP reported the discrepancy to the Inventory Manager and requested disposition instructions for the component. This often involved shipping the item back to a Stock Point for re-identification and compliance with correct disposal instructions.(3) Such administrative delays, and increased shipping and handling not only increased the Repair Turnaround Time (RTAT) for the component, but increased the risk of loss or further damage. Thus, errors caught by the HUB screening process do reduce the Total Repair Cycles of components which were originally shipped in error by the user.(3)

Because of this disagreement about the validity of the screening functions of the ATAC system, it is difficult to safely state that the ATAC system is creating a reduction of resource expenditures by the DOPs. While this is what the system was intended to do, realization of this goal is not yet fully achieved. It is apparent that improvements in this situation will occur as the bugs in the system are worked out.

Question 4 What is the significance of any changes in the transit time that are a result of the ATAC program?

Having established the premise that ATAC does, in fact, appear to reduce transit times, it was necessary to attempt to explain the value of such a condition. The answers to the final research question were derived from interviews with experts in the fields of Navy supply, repairables management, and inventory management. The concepts discussed by these experts were complex and broad in scope. Detailed discussion of all of their opinions is beyond the scope of this study. Therefore, the answer to this research question will deal briefly with two key issues: Fiscal Implications and Inventory Management.

Fiscal Implications

The cost and investment issues involved with repairables management are numerous and encompass a myriad of related topics, some quite far-removed from the subject of repairables itself. Because of the depth and intricacy of this subject, as well as the political sensitivity of some aspects, full exploration and discussion in this study is impossible. There are however, some areas of financial concern which merit inclusion in this report.

Inventory Investment. The reduction of Total Repair Cycle Time is one of the goals of the ATAC system. This, theoretically, can be achieved through the reduction of retrograde time, or via reductions in the Repair Turnaround Time. Should these reductions occur, they would permit a reduction of inventory levels of repairable components. This results from an increased ability to provide the same level of spare parts support to operating systems, using fewer spares to do it.

Because of the magnitude of inventory investments for repairables, a small percentage of that dollar amount represents a considerable sum. For example, ASO and SPCC Master Files show repairable component levels of 55,000 and 77,000 respectively.(6) The initial procurement cost of these components is in the billions of dollars. Annual replenishment costs are in the hundreds of millions of dollars.(6) Therefore, even a slight savings in either procurement or replenishment can result in the release of millions of dollars for other purposes.

Determining a meaningful estimate of the relationship between inventory investment outlays and retrograde times is no simple task. Because of the differing lengths of each component's repair cycle times, it is impossible to generate anything but an estimate of the "average" effect of change in Total Repair Cycle Time on inventory investment.(6) A study conducted by Naval Reserve officers, under the auspices of NAVSUP, investigated the relationships between reductions in Repair Turnaround Time and annual inventory replenishment costs.(6) This study and the expertise of one of the Navy's senior comptrollers formed the basis for this discussion.

Based on computer simulations of the relationship between annual replenishment costs and Repair Turnaround Time, cost savings due to reduced RTAT were predicted. Having established an aviation-related RTAT average at 67 days and a ship-related RTAT average at 167 days, three shorter RTATs were input to the computer and analyzed.(6) Tables V and VI summarize the results of this simulation.

TABLE V

Effects of RTAT Reductions on ASO Annual Replenishment Cost

RTAT Level	Days	% Cost Reduction
100%	67	0
90%	60	3.56
82%	55	6.88
75%	50	9.12

Note: Savings based on annual replenishment cost of $1.708 billion. (16)

TABLE VI

Effects of RTAT Reductions on SPCC Annual Replenishment Cost

RTAT Level	Days	% Cost Reduction
100%	167	0
87%	145	2.85
72%	120	5.79
60%	100	7.79

Note: Savings based on annual replenishment cost of $769 billion. (16)

As these tables illustrate, the magnitude of the cost avoidance possible with reductions in Repair Turnaround Time is certainly impressive. However, quantification of the similar economic impact of reductions in retrograde time have not been as fully developed. Sources at NAVSUP did allow that estimated predictions of savings in the replenishment costs of repairables inventory could be similarly determined using the same savings percentages as calculated for reductions in RTAT. This method predicts dollar savings as high as $48.6 million for a 7-day reduction in aviation-related retrograde time. Similar savings for a 40-day reduction in retrograde time for non-aviation repairables were estimated at $31.2 million.(16) It is important to remember that figures presented here are of value only to indicate the magnitude of the impact the ATAC program could have on future inventory investment decisions. They are by no means specific projections of budgetary impact.

Also of interest to the comptrollers are the reduced costs of initial provisioning of a weapon system. Because initial inventory purchases are made based on a standard value which represents the retrograde and repair pipelines, these purchases are dependent upon the magnitude of this figure. For example, if ship parts are initially procured based on a 91-day retrograde cycle, reductions of that figure will mean fewer initial purchases and less money spent.(16)

All of these savings are, of course, dependent on whether the Inventory Control Points (ASO, SPCC) agree with the validity of these figures. The decision to drastically alter initial and replenishment buying models based on this sort of data will require strong confidence in the long term future improvements of the Navy's retrograde processes.(16) Currently, the enthusiasm is not as strong as ATAC advocates might like, since inventory managers have doubts as to the predicted magnitude of ATAC improvements. But this condition reflects short-term performance. There is every reason to believe that as the ATAC system expands and is improved, long-term achievements will outstrip any hesitancy on the part of inventory managers.

Without a doubt the discussion of the fiscal implications was very brief here, given the complexity and political sensitivity of these implications. However, the intention is merely to describe the general magnitude of the cost savings implied by ATAC. As the numbers above reflect, the potential for millions of dollars in annual savings is very real, and very encouraging. Specific numbers are of little value in this study, and are quite difficult to obtain given the dynamic nature of federal financial management.

Inventory Management Issues

Perhaps one of ATAC's key advantages is its positive effect in the field of Navy inventory management and accountability. Because of the accurate carcass tracking and accountability of the ATAC data systems, it is possible to determine the location or status of an individual component once it has left the unit of origin. Although this benefit is not directly related to the effects of reducing retrograde times, the significance of such an improvement is worthy of mention. Because the Inventory Manager must oversee an immense collection of items which are constantly changing location, condition, price, and applicability, his environment is a dynamic one. Accurate record-keeping is a valuable tool in the efficient and effective performance of this job. ATAC provides this data capture.

Another benefit is the increased carcass tracking abilities of the ATAC system. As the retrograde times are shortened through special handling and premium transportation, the risks to the component are minimized, while very specific follow-up avenues are provided in the event of a misrouted component. This allows the inventory managers to keep a tighter control over their precious assets. With less lost components, there is less waste. And, in the event of a component loss, there is a traceable history which documents the movement of the missing item. This implies more recoveries of misplaced inventory and less money spent on reprocurements.

Equally important is the effect of tighter traceability on the users. As the ATAC system expands and improves, there will be fewer lost items. The period of time an ICP waits for receipt of a missing item will shorten, and sooner follow-ups will resolve discrepancies more easily. This means that using activities will pay fewer Standard Prices and improve their own resource management.

Recommendations

Based on the data analyzed and the information acquired through this research effort, the following recommendations are submitted. These recommendations are separated into two areas, the first being recommended improvements in the field of repairables management. The second area will deal with recommended areas for further study.

Recommendation 1. Based on the quantitative evidence derived through the data analysis, the ATAC program should be continued and expanded. The apparent reduction in mean transit time is a strong indication that ATAC is improving the retrograde performance of both sea and shore units. Although the full reductions cannot be totally attributed to the ATAC system, given the intended program goals and the lack of evidence to indicate otherwise, there is no reason to believe that ATAC is not responsible for the retrograde time improvements.

Personal opinions expressed by experts in the field of repairables management are almost unanimously in favor of the ATAC system. While political and philosophical arguments and concerns have been voiced and require response, they are beyond the scope of this paper. However, the overwhelming viewpoint is that the system is a very positive gain for the inventory management community and the Service in general. In addition to the benefits of the enhanced transportation methods, ATAC's component tracking and accounting will serve to reduce lost components thereby reducing fiscal obligations of the operating commands. This benefit will help alleviate the financial management difficulties encountered in our current era of budgetary constraints.

Recommendation 2. The problems encountered in manipulation of the ATAC shipping records maintained by Emery Worldwide were unnecessary and frustrating. Continued use of julian dates to record consignment dates is recommended. However, formatting of these dates as labels vice values on the dBASE II spreadsheet precludes electronic comparison of data fields. It is recommended that all julian dates be written as values to allow mathematical manipulation thereby simplifying data investigations

Recommendation 3. The methods used to create a pre-ATAC retrograde time baseline through the use of Transaction History Files were exceedingly inefficient. Manual extraction and subtraction of embedded julian dates are extremely slow and fatiguing. It is recommended that any further requirements to derive historical retrograde times be directed to the Inventory Control Points for processing with the B35 files. This method permits virtually the same data investigation as that done with History Files, but with the added ability to identify specific commands and time periods. In addition, the speed, accuracy and completeness of the data search would be greatly improved.

Recommendation 4. Further comparison of retrograde time should be conducted between similar commands or components. The evaluation of a random sample of aviation DLRs yields a very general measure of Navy wide retrograde performance. However, more specific comparisons such as between deployed non-aviation capable ships, or between afloat units deployed to specific theaters will yield more meaningful data. Too many variables can influence the length of the retrograde time of a given component and these variables would be better controlled in a more specific comparison. Also, comparisons of similar parameters can more readily identify problem areas.

Recommendations for Further Study. Because the field of repairables management is so dynamic and complex, several avenues of continued research were suggested by this study. The determination of an average time that an afloat unit holds a failed component before moving it off the ship would be helpful to supply managers. This unknown quantity adds to the uncertainty of the true measure of a component's transit time. This task is much simpler now that the ATAC system records the arrival date of a component at the HUBs. Investigation of this period will help supply managers determine more accurately the retrograde time of repairable components and assist them in assessing fleet awareness and performance in this regard.

A comparison of fleet expenditures for non-returned DLRs between pre- and post-ATAC periods would provide an estimate of possible reductions in operating expenses incurred by using activities. This comparison could determine whether fleet units are spending less money for lost or unaccounted for DLR turn-ins. Also, further study into the performance of the MAC system in handling Navy overseas freight would identify not only the average time a component spends in the hands of the Air Force, but any possible areas for improvement.

The successful use of bar coding and voice recognition technologies can significantly improve the efficiency of the ATAC screening process. Investigation into the feasibility or desirability of such technical innovations is recommended. Finally, the planned expansion of the ATAC system to include out-bound RFI materials is an important step towards improved parts support to fleet units. Investigation into the possible problems areas and urgency of need of such an expansion would benefit the Navy.

Summary

This study investigated the performance of the ATAC system with regard to reductions in retrograde time of fleet-generated "condition F" DLRs. The ATAC system was found to be effective, and a definite improvement in the field of inventory management. It is hoped that this research effort, limited as it may be, will be of interest and benefit to Navy managers. The ATAC system, even in its infancy, is capable of great improvement in the way the Navy performs its logistics functions. Any contribution this study can make towards the improvement and expansion of the Advanced Traceability and Control system is sincerely and enthusiastically offered.

Appendix A

List of Abbreviations

AFIT	Air Force Institute of Technology
ASO	Aviation Supply Office
ATAC	Advanced Traceability and Control
CINCUSNAVEUR	Commander U.S. Naval Forces, Europe
COH	Carrier Overhaul
COMNAVAIRLANT	Commander, Naval Air Forces, Atlantic
COMNAVSURFLANT	Commander, Naval Surface Forces, Atlantic
CONUS	Continental United States
CV-43	Hull Number of USS Coral Sea
CV-59	Hull Number of USS Forrestal
CV-60	Hull Number of USS Saratoga
CVN-68	Hull Number of USS Nimitz
DCN	Document Number
DLR	Depot Level Repairable
DOD	Department of Defense
DOP	Designated Overhaul Point
DSP	Designated Support Point
FLR	Field Level Repairable
FSN	Federal Stock Number
FY86	Fiscal Year 1986
HSC	Hardware Systems Command
ICP	Inventory Control Point
IM	Inventory Manager
MAC	Military Airlift Command (USAF)
MRIL	Master Repairables Item List
NAVMTO	Navy Material Transportation Office
NAVSUP	Navy Supply Systems Command
NIIN	National Item Identification Number
NRFI	Not Ready For Issue
NSC	Navy Supply Center
NSF	Navy Stock Fund
PM	Program Manager
RTAT	Repair Turnaround Time
RFI	Ready For Issue
SRA	Selected Restricted Availability
SPCC	Ships Parts Control Center
TCN	Transportation Control Number
THF	Transaction History File
TIR	Transaction Item Report
TRCT	Total Repair Cycle Time

Appendix B

Sample Data From Transaction History File (1984)

```
D6AN32 5910001531962PFEA00011V0336840031362       ARZ 1R          NNZAAF055NNZF4   SJ 4057
D6AN32 5910001531962PFEA00011V0336840031362       ARZ 1R          NNZAAF055NNZF4   SJ 4057
D7KPF T5910001531962PFEA0001N0065111971063 VV0682X  M1R79999999 WSNNZAA3015M  YY   =< 4016
BA6N32 5910001531962PFEA00012000000000000000100000000001RG0000@@@COR2A   167M A    72 4254
BA6N32 5910001531962PFEA00012000000000GJ00100000000001R00000@@@COR2B   153M J    73 4254
BA6N32 5910001531962PFEA00012000000000000000100000000001R00000@@@COR2B   253M J    73 4254
D6AN32 5910001531962PFEA00011V0336840031362       ARZ 1R          NNZAAF055NNZF4   SJ 4057
D6AN32 5910001531962PFEA00011V0336840031862       ARZ 1R          NNZAAF055NNZF4   SJ 4057
D6KN32 5910001531962PFEA00011V0336840031642       ARZ 1R          NNZAAF055NNZF4   SJ 4057
BPCN32 5910001531962PFEA0001N0065111931063 VV0682X  M1R79999999   NVZAA3015M  YY   =< 4016
BPCN32 5910001531962PFEA0001N0065111931063 VV0682X  M1R79999999   NVZAA4134M  YY   =< 4134
BPCN32 5910001531962PFEA0001N0065111931063 VV0682X  M1R79999999   NVZAA4211M  YY   =< 4211
BPCN32 5910001531962PFEA0001N0065111931063 VV0682X  M1R79999999   NVZAA4296M  YY   =< 4296
BPCN32 5910001531962PFEA0001N0065111931063 VV0682X  M1R79999999   NVZAA3015M  YY   =< 4301
BPCN32 5910001531962PFEA0001N0065111931063 VV0682X  M1R79999999   NVZAA4216M  YY   =< 4321
DZAN32 5910001531962PFEA0000400000000000000000000    1R 20000560  NVZAA 096MUPRO   =< 4134
DZAN32 5910001531962PFEA0006900000000000000000000    1R 20000560  PMZAA 036MUPRO   =< 4078
DZAN32 5910001531962PFEA0006900000000000000000000    1R 20000560  PMZAA 329MUPRO   =< 4332
DZAN32 5910001531962PFEA0000800000000000000000000    1R 20000560  PRZAA 182MUPRO   =< 4196
```

Format Key

Columns	Field Legend
1-3	Document Identifier
4-6	Routing Identifier (to)
7	Blank
8-22	Stock Number
23-24	Unit of Issue
25-29	Quantity
30-43	Document Number
44	Suffix Code
45-50	Supplementary Address
51	Signal Code
52-53	Fund Code
54-56	Distribution
57-59	Project Code
60-62	Routing Identifier
63-66	Blank
67-69	Routing Identifier(from)
70	Purpose Code
71	Supply Condition Code
72	Management Code
73-75	Transaction Item Report Date
76	Material Control Code
77-78	Blank
79-80	Financial Inventory Report Code

APPENDIX C

Sample of Emery ATAC Data

A	B	C	D	E	F	G	H	I	J	K
DAT:TCN	DAT:NIIN	DAT:DOP	DAT:QTY	DAT:WT	DAT:CUBE	DAT:TYPE	DAT:WBLL	DAT:GBL	DAT:FPD	DAT:FPT
N6287653050D611	010580158	N68621	1	1	1	EA				
N6287653050D612	001635332	N68621	1	1	1	EA				
N6287653050DF05	010737797	N68836	1	1	2	EA	SAC33044	S7867383	5324	1050
N628765305GK05	002203708	N68836	1	1	2	EA	SAC33044	S7867383	5324	1050
N628765305GK06	010439629	N68621	1	1	2	EA				
N628765305GP32	001683486	C20252	1	1	5	EA	SAC32943	JK0600307	5323	1055
N628765305GP33	005240204	N68836	1	1	4	EA	SAC33044	S7867383	5324	1050
N628765305GP34	005240201	N68836	1	1	6	EA	SAC33044	S7867383	5324	1050
N628765305GP35	004048073	N68836	1	1	1	EA				
N628765305GP36	005240229	N68836	1	1	6	EA	SAC33044	S7867383	5324	1050
N628765305GP42	008847571	N68836	1	1	2	EA				
N628765305GP43	000605103	N68619	1	1	2	EA				
N628765305GP91	002150102	N68619	1	1	1	EA				
N628765305T049	008866518	N68860	1	1	2	EA	SAC33197	JK0600355	5326	1300
N628765306G008	005580480	N68860	1	1	2	EA	SAC33197	JK0600355	5326	1300
N628765306G104	009699487	N68621	1	1	2	EA				
N628765306G105	005087109	N68619	1	1	2	EA				
N628765306GK01	001108926	N68836	1	1	6	EA				
N628765306GP51	008769656	N68619	1	1	3	EA				
N628765306GP56	004646938	N68619	1	1	2	EA				
N628765307G266	005967223	N68619	1	1	12	EA				
N628765307G311	005673136	N68619	1	1	16	EA				
N628765307GP74	008773277	N68619	1	1	1	EA				
N628765307GP76	000203211	N68619	1	1	1	EA				
N628765307GP86	007236193	N68619	1	1	2	EA				
N6287653080200	006501711	N68619	1	1	1	EA				
N6287653080201	006501711	N68619	1	1	1	EA				

L	M	N	O	P	Q	R	S	T	U
DAT:FPS	DAT:ISD	DAT:IST	DAT:ISS	DAT:OSD	DAT:OST	DAT:OSS	DAT:IMD	DAT:IMT	DAT:IMS
	5310	1958	1027	5311	0900	BREAUX	5311	1930	SK3 PEREZ
	5311	1757	1027	5312	1000	BREAUX	5312	2200	SK2 IGNACIO
WACHINGTON	5312	1810	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ
WASHINGTON	5311	1757	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ
	5317	1701	1027	5318	0900	BREAUX	5318	1830	SSGT. BARE
STEVEN	5311	1758	1027	5312	1000	BREAUX	5312	2200	SK2 IGNACIO
WASHINGTON	5311	1758	1027	5312	1000	BREAUX	5312	2200	SK2 IGNACIO
WASHINGTON	5311	1757	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ
	5311	1757	1027	5312	1000	BREAUX	5312	2200	SK2 IGNACIO
WASHINGTON	5311	1757	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ
	5318	1928	1027	5319	0900	METCALF	5319	2030	SK2 FALLETTA
	5318	1927	1027	5319	0900	METCALF	5319	2030	SK2 FALLETTA
				5338	0900	BREAUX	5338	2150	SK2 ARCANGEL
SAWULTO	5317	1733	1027	5318	0900	BREAUX	5318	1830	SSGT. BARE
SAWULTO	5317	1728	1027	5318	0900	BREAUX	5318	1830	SSGT. BARE
	5318	1928	1027	5319	0900	METCALF	5319	2030	SK2 FALLETTA
	5317	1701	1027	5318	0900	BREAUX	5318	1830	SSGT. BARE
				5342	0730	WEBER	5342	2030	SK2 FALLETA
	5317	1702	1027	5319	0900	METCALF	5319	2030	SK2 FALLETTA
	5317	1729	1027	5318	0900	BREAUX	5318	1830	SSGT. BARE
				5337	0800	WEBER	5337	2140	SK2 ARCANGEL
	5326	1800	1027	5327	0800	BREAUX	5327	1950	SK2 VALDEZ
				5342	0730	WEBER	5342	2030	SK2 FALLETA
	5312	1811	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ
	5317	1729	1027	5318	0900	BREAUX	5318	1830	SSGT. BARE
	5312	1812	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ
	5312	1812	1027	5313	1000	BREAUX	5313	1930	SK2 VALDEZ

V	W	X	Y
DAT:OMD	DAT:OMT	DAT:OMS	DAT:FLAG
5322	1330	K JENNI	
5322	1330	K JENNI	
5322	1330	K JENNI	
5322	1330	K JENNI	
5322	1330	K JENNI	
5322	1330	K JENNI	
5325	1410	K JENNY	
5325	1410	K JENNY	
5345	1300	K. JENNI	
5323	1040	K JENNY	
5323	1040	K JENNY	
5323	1040	K JENNY	
5347	1400	K JENNI	
5325	1410	K JENNY	
5323	1040	K JENNY	
5351	1400	K JENNI	
5336	1330	KIRK JENNI	
5347	1400	K JENNI	
5323	1040	K JENNY	
5323	1040	K JENNY	
5323	1040	K JENNY	
5323	1040	K JENNY	

Emery ATAC Data Description

Column	Data Field Description
A	Transportation Control Number
B	National Item Identification Number (NIIN)
C	Unit Identification Code of Designated Overhaul Point
D	Quantity Shipped
E	Weight (these entries are not correct)
F	Dimensions of Package (cu. ft.)
G	Unit of Issue
H	Waybill Number
I	Government Bill of Lading Number
J	Julian Date of Arrival at DOP
K	Time of Arrival at DOP
L	Consignor (DOP Arrival)
M	Julian Date of Arrival at HUB for Screening
N	Time of Hub Arrival
O	Unknown (should be consignor's name)
P	Julian Date Out of Screening
Q	Time Out of Screening
R	Consignor (Out of Screening)
S	Julian Date of Entry into Military Airlift Command (MAC)
T	Time of Entry into MAC
U	Consignor
V	Julian Date Out of MAC
W	Time Out of MAC
X	Consignor (Out of MAC)
Y	Unused

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Vita

Lieutenant Michael J. Stapleton was born on 10 December 1958 in Chicago, Illinois. He graduated from high school in Barrington, Rhode Island in 1976 and entered the U.S. Naval Academy in Annapolis, Maryland. Upon completion of requirements for a Bachelor of Science degree, he was graduated and commissioned an Ensign, USN in 1980, and received orders for flight training in Pensacola, Florida. In 1981, he was designated a naval helicopter pilot and was selected for training as a CH-46 Vertical Replenishment pilot. He then completed a three year assignment in Helicopter Combat Support Squadron Six (HC-6) in Norfolk, Virginia, and in 1985 entered the School of Systems and Logistics, Air Force Institute of Technology. His subsequent assignment will be aboard USS Okinawa (LPH-3) in San Diego, California.

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The U.S. Navy has been constantly updating its collection of logistical support systems which are in place to provide world-wide support for fleet units. Such efforts have resulted in a new system for processing failed depot-level repairable components. The "Advanced Traceability and Control", or "ATAC" system uses techniques and procedures similar to those of commercial freight handlers to expeditiously transport and account for components being shipped to repair sites from Navy units all over the world. Because this system is so new, it has not been fully tested and compared with the previous system.

This thesis investigated the effect of the ATAC system on average transit or "retrograde" time of components being sent back for stateside repair. This evaluation compared the pre-ATAC mean retrograde time of failed components with that of items shipped via the new system. The results of the comparison indicated that the ATAC system seems to reduce the time a component spends in shipment. The implications of this discovery were discussed in terms of the financial impact and inventory management improvements of such a reduction. The thesis drew on the knowledge of experts in the field of Navy inventory management, repairables management, supply, and finance to determine the potential significance of the ATAC system as implied by the results of the study. The overall conclusion contends that potential cost avoidance and savings in several areas are possible due to the increased efficiency of the ATAC system.

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